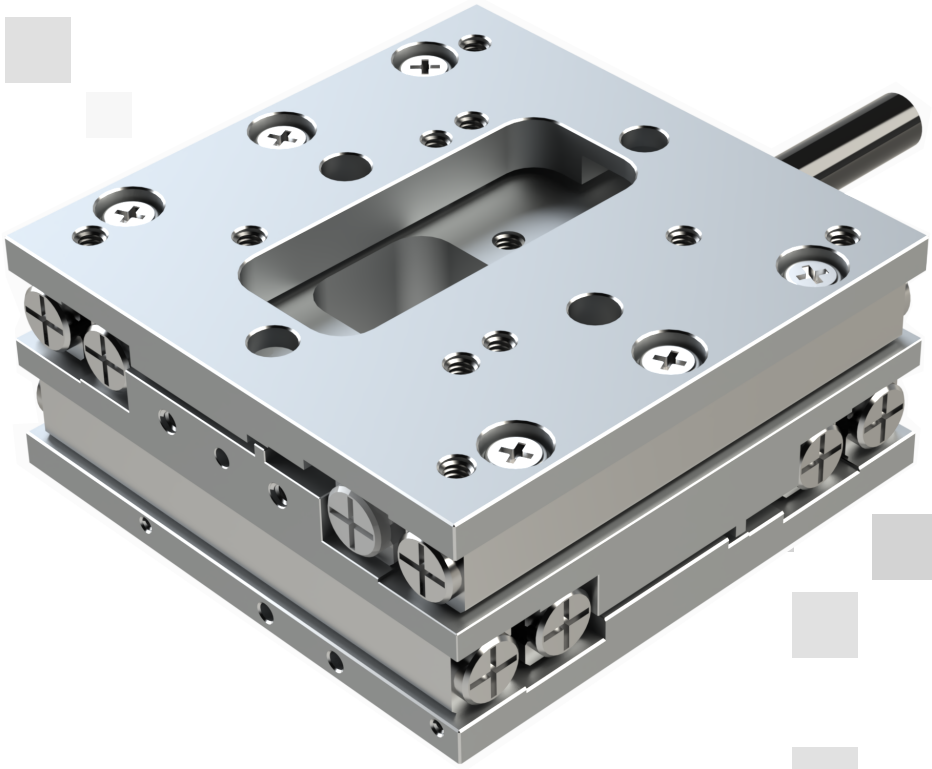
PPX-32CR

Series



Precision Positioner Stage

Reference Manual

(Open and Closed Loop Versions)

micronix USA
PRECISION MOTION SOLUTIONS

PPX-32CR

Piezo Precision XY Stage
Reference Manual

Rev 2.0

MICRONIX USA, LLC
Tel: 949-480-0538
Email: info@micronixusa.com
http://micronixusa.com

Table of Contents

1. Introduction

1.1 Product Description

The PPX-32CR is a low profile, integrated XY stage with a height of only 14 mm and an open aperture design. Cross roller bearings ensure smooth and stable motion for loads up to 10 N. It utilizes a multi-phase piezo motor resulting in high speed (> 10 mm/s) and high blocking force (> 2 N).

The PPX-32CR is available in open-loop and closed-loop configurations, with closed-loop resolution down to 2 nm. Vacuum compatible versions rated to 10^{-9} mbar, as well as non-magnetic variants, are also available. PPX-32CR is compatible with the MMC-100, MMC-110, NanoDrive, and MMX-120 controllers.

Product Specifications	**PPX-32CR Piezo Motor**
Travel	18mm x 18mm
Max Speed	>10mm/s
Max Load	1 kg
Open Loop Resolution	1 nm
Closed Loop Resolution	2 nm

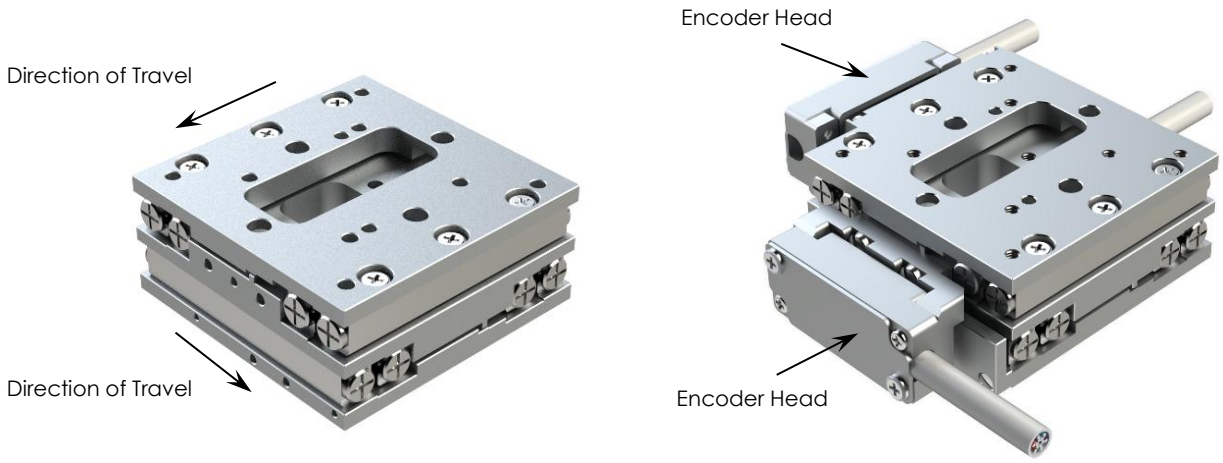


Figure 1-A. PPX-32CR, Open Loop Version (left), Closed Loop Version (right)

1.2 Recommended Controllers

The following controllers are available from MICRONIX USA:

Controller	Piezo Motor	Analog Encoder	Digital Encoder
MMC-100	✓	✓	✓
MMC-110	✓	✓	✓
NanoDrive	✓		✓
MMX-120	✓	✓	✓

CAUTION: Ensure the controller is compatible with the stage's motor and feedback signals and that connector types match before connecting. Improper connections or incompatibility may cause damage to the stage or controller.

1.3 Technical Data and Ordering Information

Detailed specifications and ordering information can be found on the PPX-32CR product page on the MICRONIX USA website.

2. Preparing to Install the PPX-32CR Stage

2.1 Installation Preparation

When mounting the stage, it is important to consider the flatness of the mounting surface, as the stage will conform to the shape of that surface. The stage's performance and structural integrity are impacted by the mounting flatness.

The stage specification is tested at a temperature of 20°C ± 5°C unless otherwise specified. Ensure the following conditions are met before operating the stage:

- Mounting surface is clean and free of debris, burrs or dings.
- It is recommended that the mounting surface has a flatness of <0.001" or <25µm.
- Indoor atmosphere is free of corrosive gases, excessive dust, and condensation.
- Operating temperature range of 5-40°C.
- Relative humidity between 20-80%.
- The stage is located away from water, heat, and electrical noise.

2.2 Product Handling

- The PPX-32CR is a precision mechanical device and should be handled with care. Do not drop or mishandle the stage.
- Do not touch the scale or ceramic track, as this will contaminate and jeopardize the performance of the stage.
- Keep hands clear of all moving parts while the stage is in motion to avoid personal injury.
- Use proper cable management to ensure a clean and safe operating environment.
- Properly connect the stage to the controller before powering on the controller. Failure to do so can result in damage to the stage.
- Allow for easy access to the stage in case of servicing.

NOTE: Piezo stages use friction-based motion with ceramic components that are sensitive to oils. Wear powder-free nitrile gloves when handling the stage to avoid contamination.

NOTE: It is possible to gently move the carriage manually without damaging the stage.

2.3 Package Contents

The package contains all necessary components for the PPX-32CR stage setup. If the product is damaged or there are missing components, contact MICRONIX USA immediately. Do not discard product packaging in case of return shipment.

Package Contents:

- PPX-32CR Piezo XY Stage
- Reference Manual
- Any additional components specified in the order, such as a controller

3. Installing the PPX-32CR Stage

3.1 PPX-32CR Installation

NOTE: It is possible to gently move the carriage manually without damaging the stage.

Follow these steps to securely mount the PPX-32CR Stage.

1. Align the stage to the mounting surface using two M1.5 dowel pins.
2. Secure the stage to the mounting surface using two M2 socket head cap screws at 0.5 Nm recommended torque.

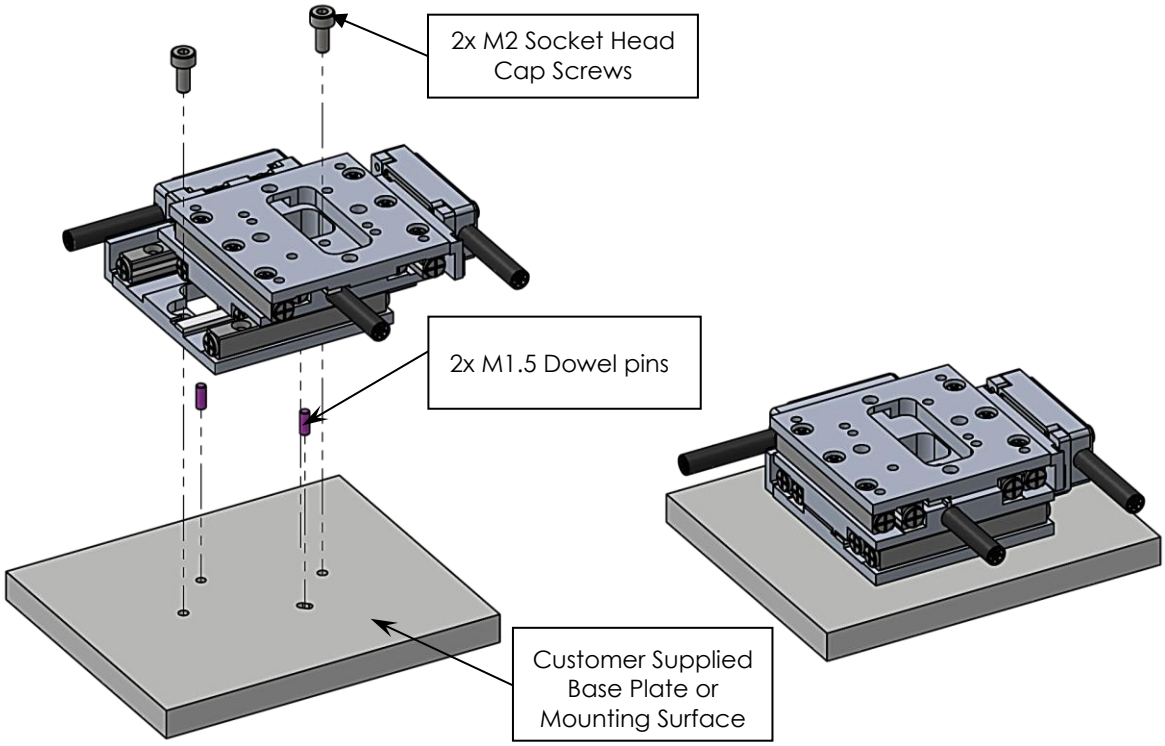
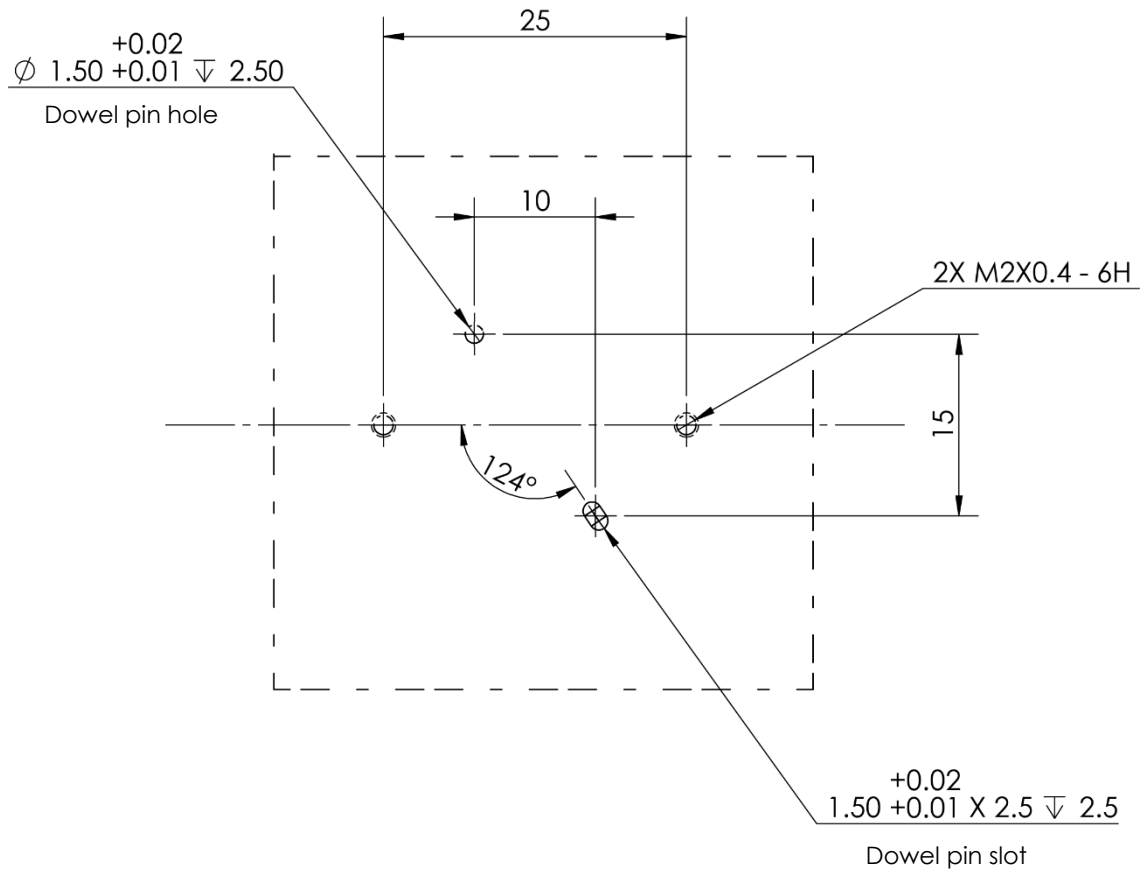


Figure 3-A. PPX-32CR General Mounting Installation

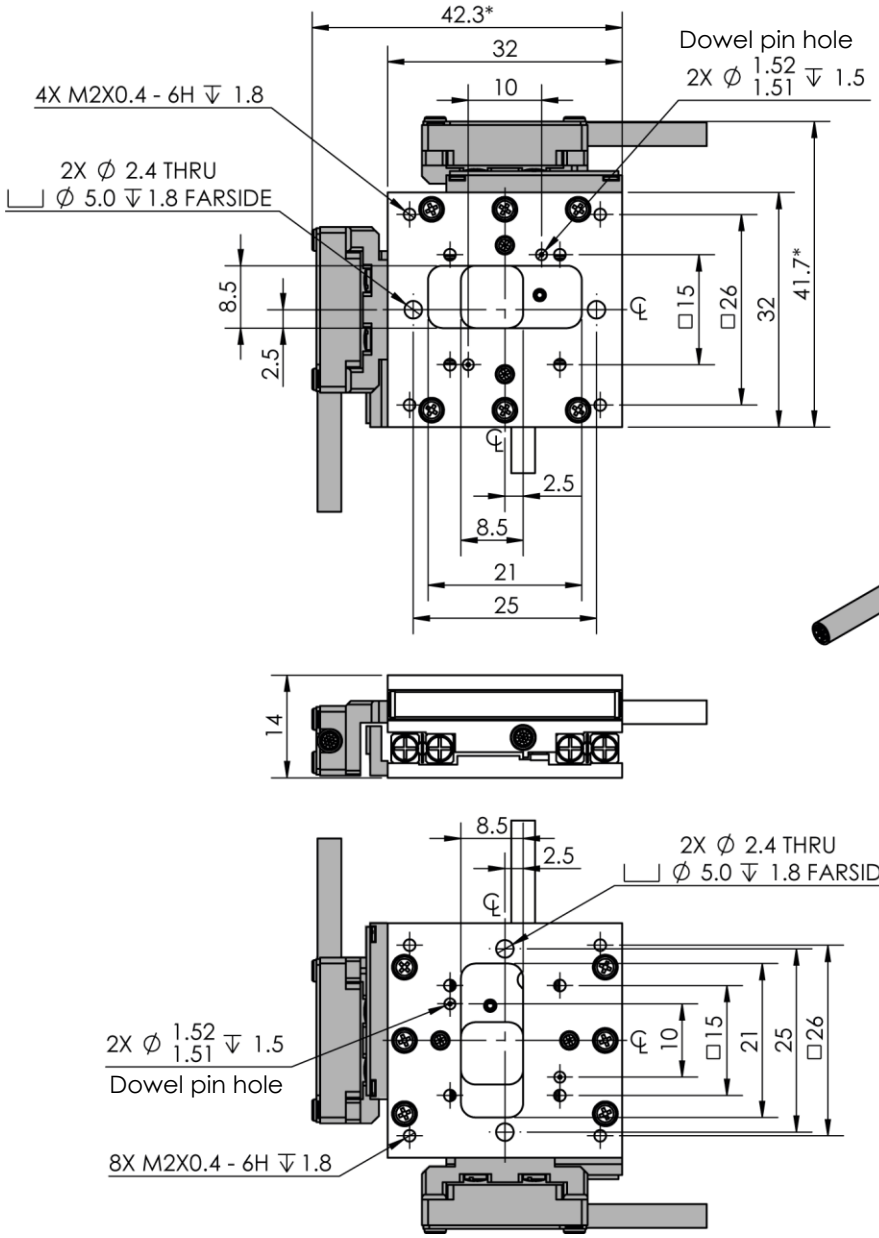
3.1.1 General Mounting Pattern

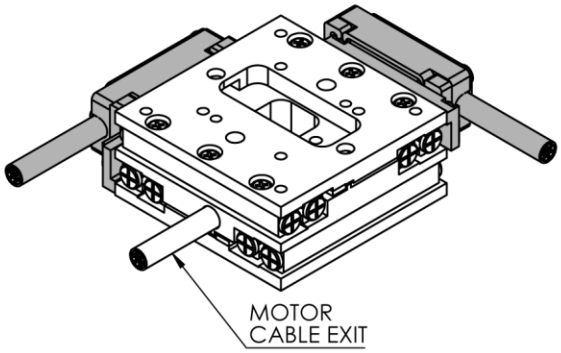
It is recommended to use a pin-slot hole pattern for dowel pin alignment.



4. Dimensions

4.1 PPX-32CR Standard Dimensions

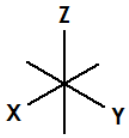




*Grey parts are for closed loop version only
*All dimensions in millimeters

5. Stacking Configurations (Examples)

- Additional configurations are available upon request.
- Images are positioned according to:

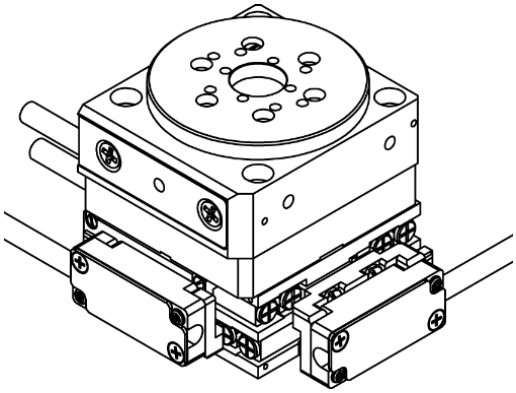


5.1 PPX-32CR Interface with Other MICRONIX Stages

The PPX-32CR can be mounted directly onto a range of MICRONIX stages, enabling flexible multi-axis configurations. Below are examples of stages that support direct mounting without the need for an adapter bracket. If an adapter is required, contact MICRONIX USA for assistance.

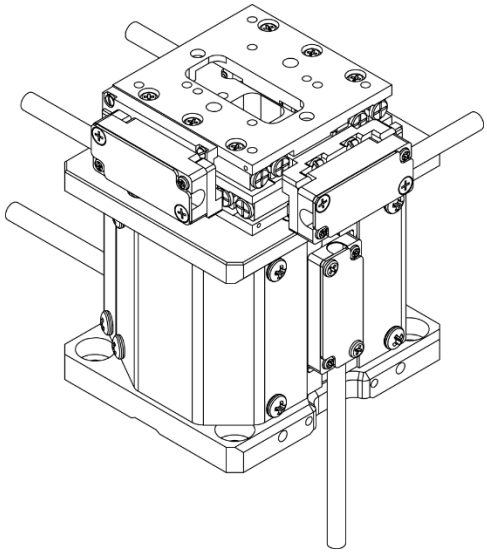
5.1.1 PR-32L + PPX-32CR, Rotation + XY Translation

The PR-32L can mount directly on PPX-32CR for 360° with up to 18mm XY travel.



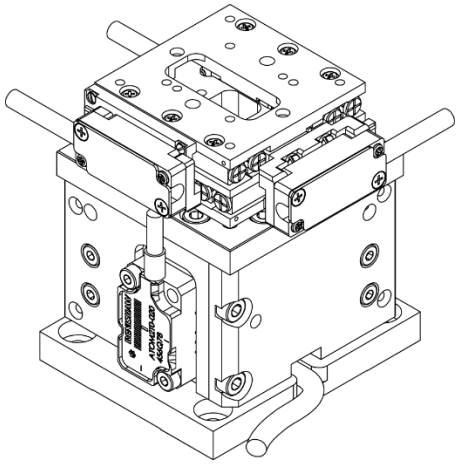
5.1.2 ES-50PM + PPX-32CR, Elevation Stage + XY Translation

The PPX-32CR can mount directly on the ES-50PM for elevation of up to 10mm and 18mm XY travel.



5.1.3 ES-50SM + PPX-32CR, Elevation Stage + XY Translation

The PPX-32CR can mount directly on the ES-50SM for elevation of up to 10mm and 18mm XY travel.



6. Connecting the PPX-32CR Stage

6.1 Atmospheric Environments (MMC-Controller)

For controller information, refer to the appropriate MMC controller manual.

6.1.1 Open Loop, Atmospheric Wiring Diagram

Connecting the PPX-32CR stage in an open loop configuration only requires that the D-sub 9 Pin motor cables be connected to a compatible controller. No other cables or components are required. Connect the stage as shown below. For details regarding the pinout see Appendix Section A.2.1.

Cable Descriptions:

A1. Motor Cable (Male D-sub 9 Pin, 1.5m PVC Black Cable)
A2. Motor Cable (Male D-sub 9 Pin, 0.15m PVC Black Cable)

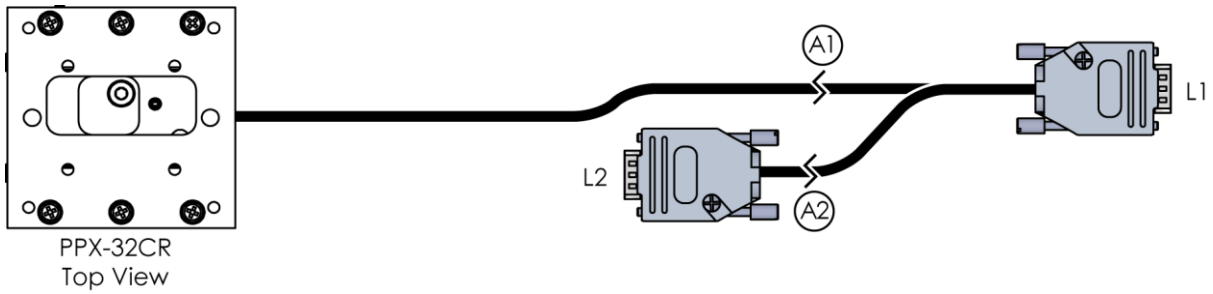


Figure 6-A. PPX-32CR, Piezo Motor, Open Loop, Atmospheric Wiring Diagram

6.1.2 Closed Loop (Encoder), Atmospheric Wiring Diagram

See Appendix Section A.2.2 and A.2.3 for analog and digital pinout information respectively.

Cable Descriptions:

A. Encoder Cable (Female D-sub 9 Pin, 1.5m PVC Black Cable)
B1. Motor Cable (Male D-sub 9 Pin, 1.5m PVC Black Cable)
B2. Motor Cable (Male D-sub 9 Pin, 0.15m PVC Black Cable)

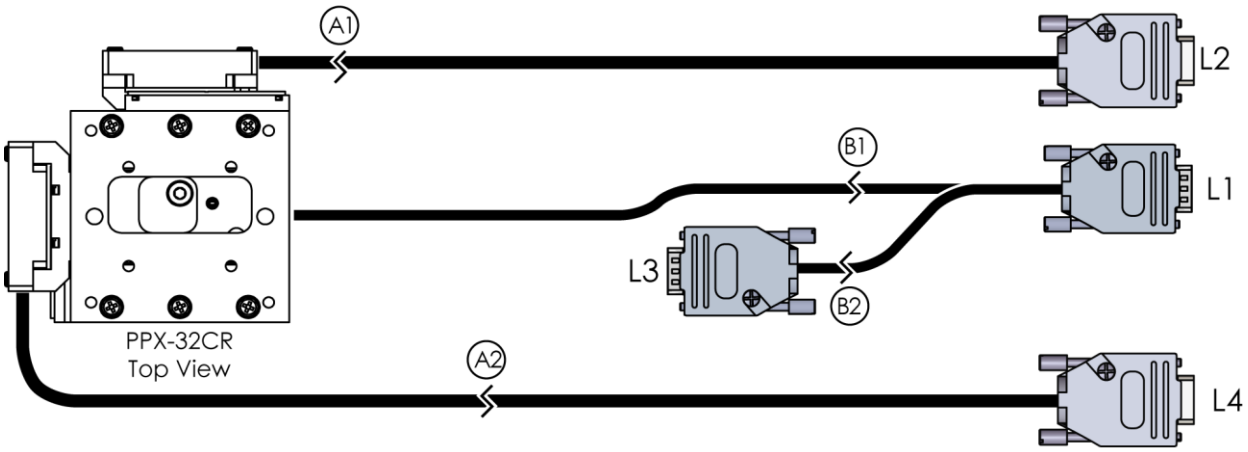


Figure 6-B. PPX-32CR, Piezo Motor, Closed Loop, Atmospheric Wiring Diagram,

6.2 *Vacuum Environments*

6.2.1 Handling and Preparation

When handling stages configured for vacuum use, take the necessary precautions, such as wearing powder-free nitrile gloves, cleanroom garments, etc. to avoid any contaminants. Maximum bake-out temperature is 100°C. As standard, the stage is supplied with non-vacuum-compatible connectors. MICRONIX USA optionally offers this stage supplied with vacuum-rated connectors installed, see chart below.

Connector Description	Connector Material	Contacts	Backshell
High Vacuum Glass- filled Diallyl Phthalate D-Subminiature	DAP	T2 Female Crimps, Gold Pins (Accuglass P/N: 111652)	Nickel-plated Zinc Backshell Strain Relief
Ultra-High Vacuum D-Subminiature	PEEK	T1 Female Crimps, Gold Pins (Accuglass P/N: 100180)	PEEK UHV Strain Relief

Environment	Open Loop	Closed Loop
High Vacuum (10^{-6} mbar)	9 Pin Female DAP	15 Pin Female DAP
Ultra-High Vacuum (10^{-9} mbar)	9 Pin Female PEEK	15 Pin Female PEEK

Connecting a PPX-32CR in a vacuum chamber requires the use of a feedthrough connector at the vacuum chamber wall. For final application, the customer is responsible for providing their own feedthrough connection.

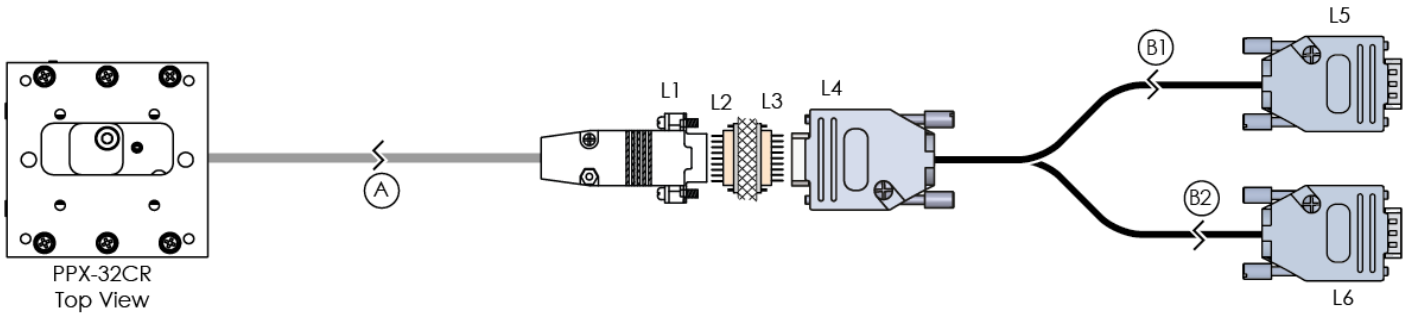
The vacuum compatible PPX-32CR includes a straight through feedthrough (not a cross over gender changer). MICRONIX USA supplies test connectors that simulate the vacuum feedthrough to allow for functionality testing prior to installation in a vacuum chamber. See Appendix Section A.4 for feedthrough pins.

6.2.2 Open Loop, Vacuum Wiring Diagram

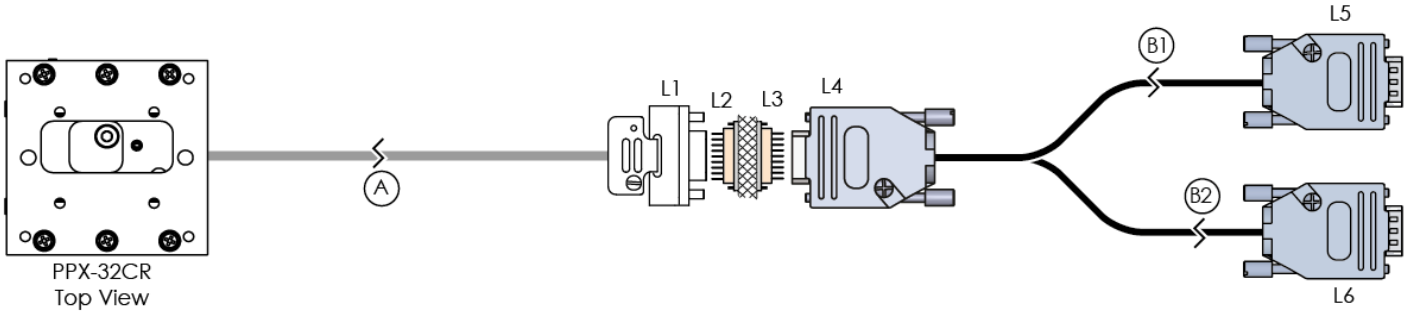
See Appendix Section A.2.4 for pinout information.

Cable Descriptions:

A. Vacuum Motor Cable (Female D-sub 9 Pin, 1.5m Silver Braided Cable)
B. Atmospheric Motor Cable (Female D-sub 9 Pin to Male D-sub 9 Pin, 1.5m PVC Black Cable)



HV Connector



UHV Connector

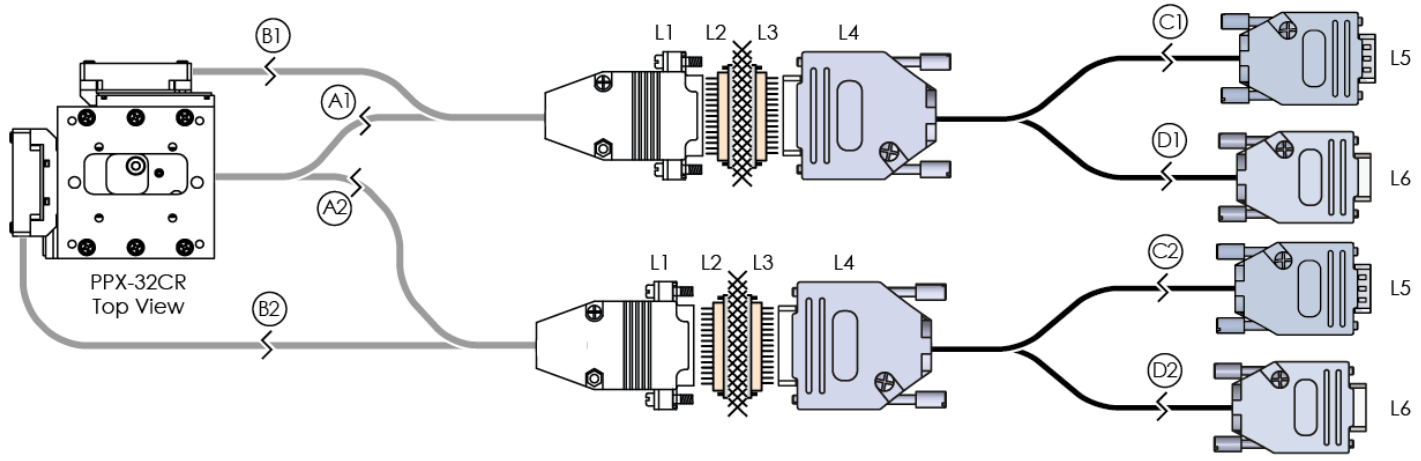
Figure 6-C. PPX-32CR, Piezo Motor, Open Loop, Vacuum Wiring Diagram

6.2.3 Closed Loop (Encoder), Vacuum Wiring Diagram

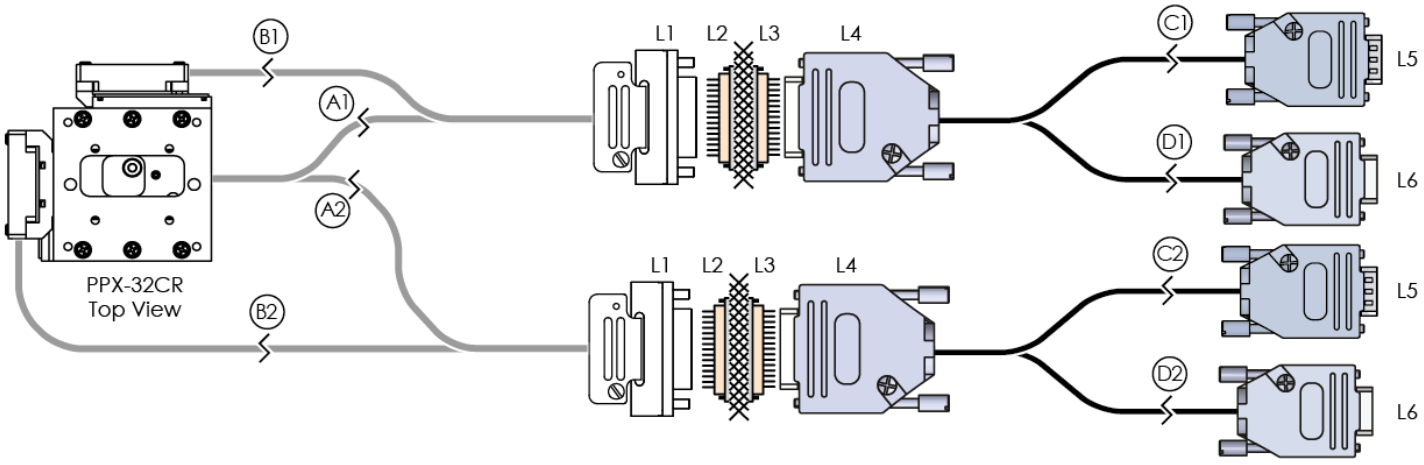
See Appendix Section A.2.5 and A.2.6 for analog and digital pinout information respectively.

Cable Descriptions:

A. Motor Vacuum Cable (Female D-sub 15 Pin PEEK or DAP, 1.5m Silver Braided Cable)
B. Encoder Vacuum Cable (Female D-sub 15 Pin PEEK or DAP, 1.5m Silver Braided Cable)
C. Motor Breakout Cable (Female D-sub 15 Pin to Male D-sub 9 Pin, 1.5m PVC Black Cable)
D. Encoder Breakout Cable (Female D-sub 15 Pin to Female D-sub 9 Pin Module, 1.5m PVC Black Cable)



HV Connector



UHV Connector

Figure 6-D. PPX-32CR, Piezo Motor, Closed Loop, Vacuum Wiring Diagram

7. Supplementary Information

7.1 Maintenance and Handling

The PPX-32CR stage utilizes a maintenance-free design. Do not modify the stage or perform any maintenance unless specifically instructed to do so by MICRONIX USA personnel. If the stage is not performing up to the original specifications, please contact MICRONIX USA.

7.2 Units and Conventions

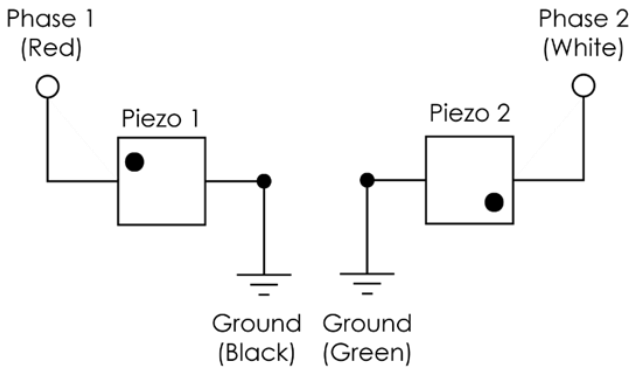
All measurements in this document are in the metric system of units.

Metric Unit	English Unit
1 millimeter	0.0394 inches
1 micron	0.0000394 inches
1 Newton	0.2248 lbs.
1 Newton-meter	8.85 in-lbs.

A. Appendix

A.1 Piezo Motor Electrical Specifications

A.1.1 2 Phase Piezo Motor Wiring Diagram



A.1.2 Piezo Motor Specifications

Voltage	60V maximum
Capacitance	150nF ±15%

A.2 Wiring Pinouts

A.2.1 PPX-32CR – Piezo, Open Loop, Atmospheric Pinout

See Figure 6-A.

Pinout for PPX-32CR-11000 — Cable A1 D-sub 9M

Motor 1

Description	Color	L1
Phase 1	Red	1
Phase 2	White (Green TP)	2
Ground	Black/Green	5
Shield	-	Casing

Pinout for PPX-32CR-11000 — Cable A2 D-sub 9M

Motor 2

Description	Color	L1
Phase 1	White (Grey TP)	1
Phase 2	White (Blue TP)	2
Ground	Grey/Blue	5
Shield	-	Casing

A.2.2 PPX-32CR Piezo, Analog, Atmospheric Pinout

See Figure 6-B.

Pinout for PPX-32CR-11200 — Cable B1 D-sub 9M

Motor 1

Description	Color	L1
Phase 1	Red	1
Phase 2	White (Green TP)	2
Ground	Black/Green	5
Shield	-	Casing

Cable A1 D-sub 9F

Encoder 1

Description	Color	L2
Cos+/A+	Brown	1
Sin+/B+	Blue	2
Index+/Z+	Violet	3
GND	Grey	4
+5V	White (Grey TP)	5
Cos-/A-	White (Brown TP)	6
Sin-/B-	White (Blue TP)	7
Index-/Z-	White (Violet TP)	8
Shield	-	Casing

Pinout for PPX-32CR-11200 — Cable B2 D-sub 9M

Motor 2

Description	Color	L3
Phase 1	White (Grey TP)	1
Phase 2	White (Blue TP)	2
Ground	Grey/Blue	5
Shield	-	Casing

Cable A2 D-sub 9F

Encoder 2

Description	Color	L4
Cos+/A+	Brown	1
Sin+/B+	Blue	2
Index+/Z+	Violet	3
GND	Grey	4
+5V	White (Grey TP)	5
Cos-/A-	White (Brown TP)	6
Sin-/B-	White (Blue TP)	7
Index-/Z-	White (Violet TP)	8
Shield	-	Casing

A.2.3 PPX-32CR-11300 – Piezo, Digital, Atmospheric Pinout

See Figure 6-B.

Motor C1

Pinout for PPX-32CR-11300 — Cable C1 D-sub 9M

Description	Color	L4
Phase 1	Red	1
Phase 2	White (Green TP)	2
Ground	Black/Green	5
Shield	-	Casing

Encoder A1 & B1

Cable A1 D-sub 15M — Cable B1 D-sub15F / D-sub 9F

Description	L1	Color	L2	L3
Ground	2	Grey	2	4
Index-	4	White (Violet)	4	8
B-	5	White (Blue)	5	7
A-	6	White (Brown)	6	6
+5VDC	7	White (Grey)	7	5
Index+	12	Violet	12	3
B+	13	Blue	13	2
A+	14	Brown	14	1
Shield	Casing	-	Casing	Casing

Motor C2

Pinout for PPX-32CR-11300 — Cable C2 D-sub 9M

Description	Color	L4
Phase 1	White (Grey TP)	1
Phase 2	White (Blue TP)	2
Ground	Grey/Blue	5
Shield	-	Casing

Encoder A2 & B2

Cable A2 D-sub 15M — Cable B2 D-sub 15F / D-sub 9F

Description	L1	Color	L2	L3
Ground	2	Grey	2	4
Index-	4	White (Violet)	4	8
B-	5	White (Blue)	5	7
A-	6	White (Brown)	6	6
+5VDC	7	White (Grey)	7	5
Index+	12	Violet	12	3
B+	13	Blue	13	2
A+	14	Brown	14	1
Shield	Casing	-	Casing	Casing

A.2.4 PPX-32CR-11006/9 – Piezo, Open Loop, Vacuum Pinout

See Figure 6-C.

Motor

Pinout for PPX-32CR-11006/11009 — Cable A D-sub 9F — Feedthrough D-sub 9M — Cable B D-sub 9F / D-sub 9M

Description	Color	L1	L2	L3	Color	L4	L5
Motor 1, Phase 1	Red	5	5	1	Red	1	1
Motor 1, Phase 2	White (Green TP)	4	4	2	White (Green TP)	2	2
Motor 1, Ground	Black/Green	1	1	5	Black/Green	5	5
Motor 2, Ground	Grey/Blue	1	1	5	Grey/Blue	5	5
Shield	-	6	6	9	-	9	Casing

A.2.5 PPX-32CR-11206– Piezo, Analog Encoder, Vacuum Pinout

See Figure 6-D.

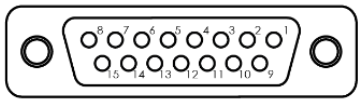
	Pinout for PPX-32CR-11206		Cable A&B D-sub 15F	Feedthrough D-sub 15M			D-sub 15F	Cable C D-sub 9M	Cable D D-sub 9F
	Description	**Color**	**L1**	**L2**	**L3**	**Color**	**L4**	**L5**	**L6**
Motor A & C	Motor 1, Phase 1	Red	1	1	8	Red	8	8	-
	Motor 1, Phase 2	Green (White TP)	2	2	7	Green (White TP)	7	7	-
	Motor 1 GND	Black, Green	9	9	15	Black, Green	15	15	-
	Shield	-	10	10	14	-	14	14	-
Encoder B & D	Encoder GND	Grey	8	8	1	Grey	1	-	4
	SLO + / Data +	Blue	7	7	2	Blue	2	-	1
	+ 5VDC	White (Grey TP)	6	6	3	White (Grey TP)	3	-	5
	SLO - / Data -	White (Blue TP)	5	5	4	White (Blue TP)	4	-	6
	MA + / CLK +	Brown	4	4	5	Brown	5	-	2
	MA - / CLK -	White (Brown TP)	12	12	12	White (Brown TP)	12	-	7
	SLI -	White (Violet TP)	13	13	11	White (Violet TP)	11	-	8
	SLI +	Violet	14	14	10	Violet	10	-	3
	Encoder Shield	-	15	15	9	-	9	-	Casing

A.2.6 PPX-32CR-11306/9 – Piezo, Digital Encoder, Vacuum Pinout

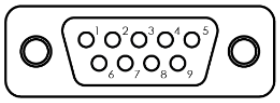
See Figure 6-D.

	Pinout for PPX-32CR-11306/11309		Cable A&B D-sub 15F	Feedthrough D-sub 15M			D-sub 15F	Cable C D-sub 9M	Cable D D-sub 9F
	Description	**Color**	**L1**	**L2**	**L3**	**Color**	**L4**	**L5**	**L6**
Motor A & C	Motor 1, Phase 1	Red	1	1	8	Red	8	1	-
	Motor 1, Phase 2	White (Green TP)	2	2	7	White (Green TP)	7	2	-
	Motor 1 GND	Black, Green	9	9	15	Black, Green	15	5	-
	Shield	-	10	10	14	-	14	Casing	-
Encoder B & D	A+	Brown	7	7	2	Brown	2	-	1
	B+	Blue	4	4	5	Blue	5	-	2
	Index+	Violet	14	14	10	Violet	10	-	3
	GND	Grey	8	8	1	Grey	1	-	4
	+5V	White (Grey TP)	6	6	3	White (Grey TP)	3	-	5
	A-	White (Brown TP)	5	5	4	White (Brown TP)	4	-	6
	B-	White (Blue TP)	12	12	12	White (Blue TP)	12	-	7
	Index-	White (Violet TP)	13	13	11	White (Violet TP)	11	-	8
	Shield	-	15	15	9	-	9	-	Casing

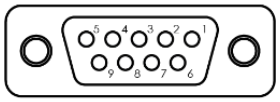
A.3 Standard D-sub Connector Pinout



Dsub15F - Front View
15 Pin Female Connector



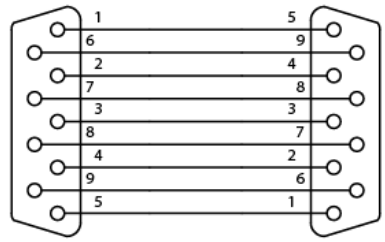
Dsub9M - Front View
9 Pin Male Connector



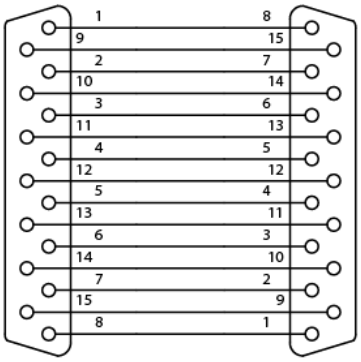
Dsub9F - Front View
9 Pin Female Connector

A.4 Vacuum Feedthrough Pinout

Recommended feedthrough pinout based on off the shelf feedthroughs.



Male DB9 Male DB9



Male DB15 Male DB15

A.5 Using an Analog Encoder

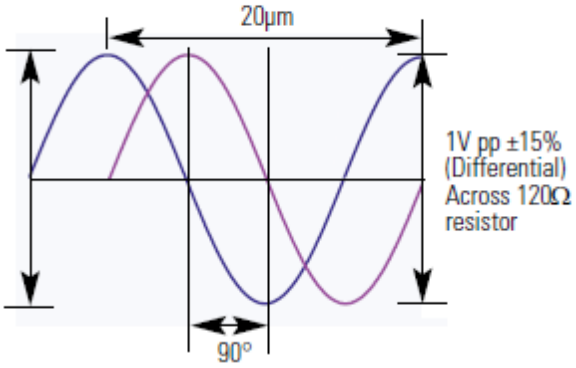
A.5.1 Encoder Overview

A PPX-32CR with analog encoder will need to be paired with an appropriate controller that supports 1 Vpp sine/cosine encoders such as the MMC-100 and MMC-110. The PPX-32CR with an analog encoder will be supplied with a D-sub 9 pin connector that incorporates these encoder signals.

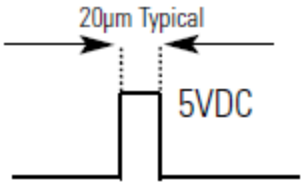
A.5.2 Operating and Electrical Specifications

Power Supply	5VDC ±5% @ 330mA (60mA for sensor)

A.5.3 Analog Output (Pins 1, 2, 6, and 7)



A.5.4 Index Window



A.5.5 Resolution

All closed loop stages are supplied with 20 µm scales. The interpolation is done in the MMC-100/MMC-110 to the resolution as specified in the order. With an analog encoder, the MMC-100/MMC-110 has an achievable resolution of 10 nm.

A.6 Using the Digital Encoder

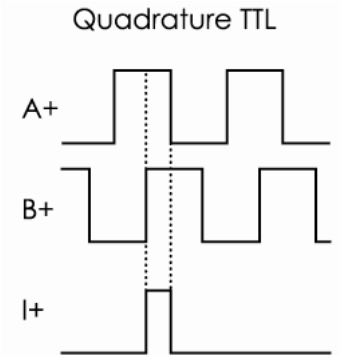
A.6.1 Encoder Overview

The PPX-32CR with digital encoder must be paired with an appropriate controller. The PPX-32CR with a digital encoder will be supplied with a D-sub 9 pin connector that incorporates these encoder signals.

A.6.2 Operating and Electrical Specifications

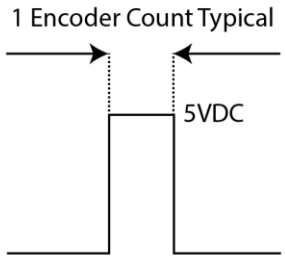
Power Supply	5VDC ±10% @ < 35mA (No outputs terminated) @ < 85mA (A, B, I, and both limits terminated); 50mA at the sensor

A.6.3 Output Signals



NOTE: The index pulse may be aligned with A- or B- at some interpolation values.

A.6.4 Index Window



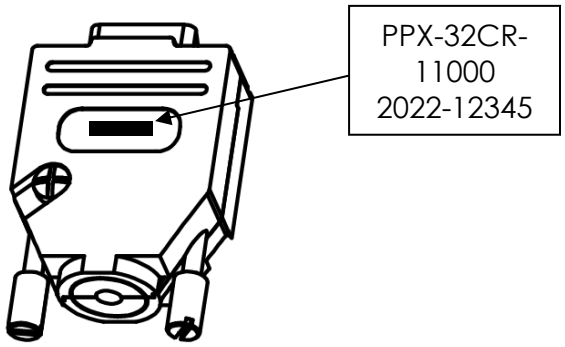
A.6.5 Resolution

All closed loop stages are supplied with 20µm scales. The digital encoder module interpolates to a higher resolution as specified in the order. With a digital encoder an MMC controller has an achievable resolution of 2nm.

A.7 Legacy

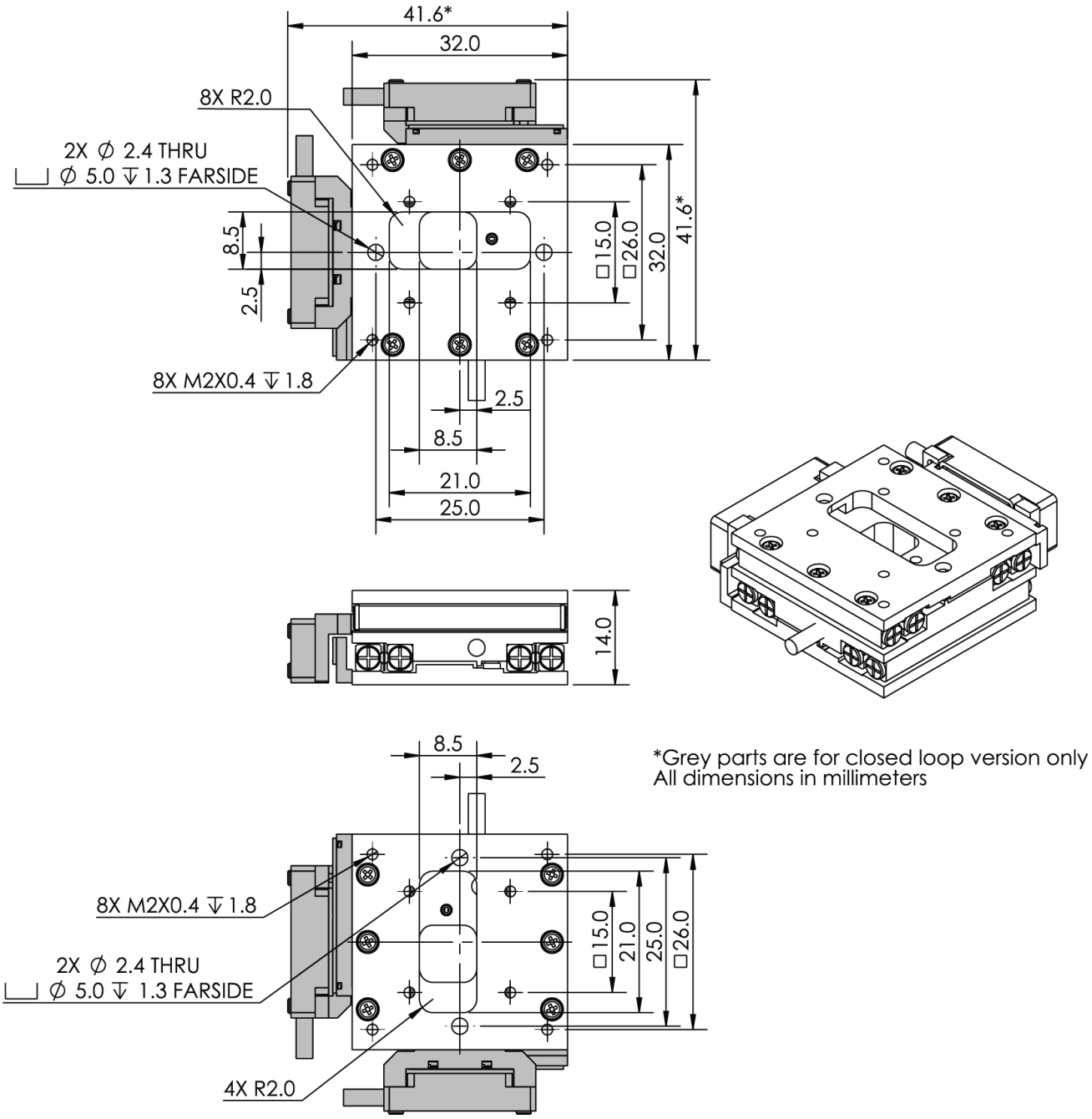
Stages delivered before 2022 used the 8 Conductor wiring scheme.
Stages delivered in 2022 and afterward use the 12 Conductor wiring scheme.

Customers can find the serial number of their stages which can usually be found on the male D-sub 9 pin connector with the format: 1234-56789 where the first four digits are the year.



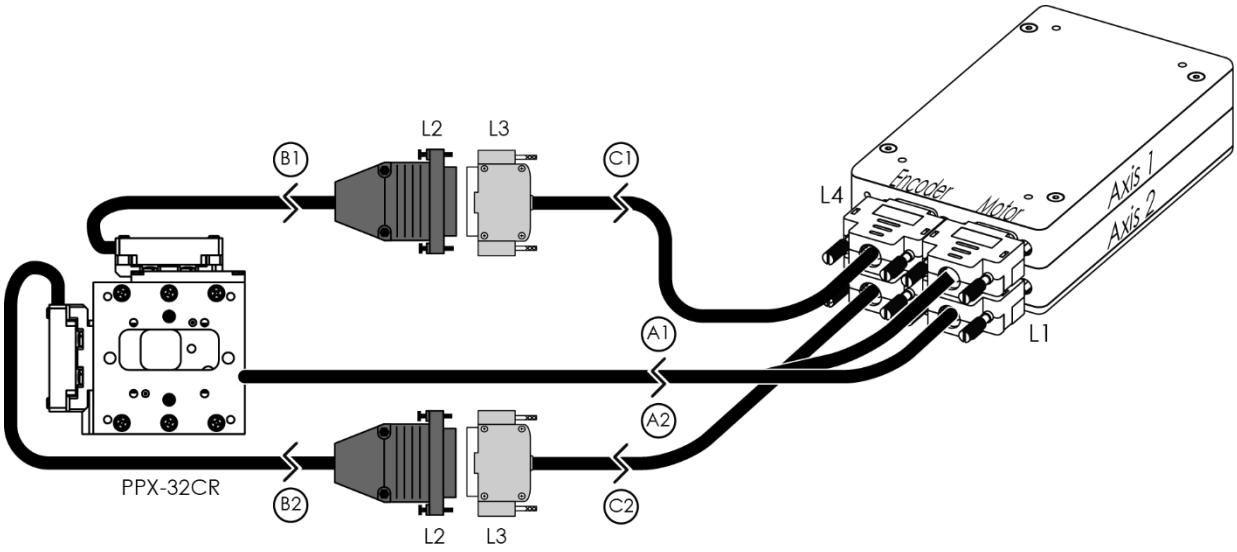
Description	8 Conductor Wiring	12 Conductor Wiring
Motor Phase 1	Red	Red
Motor Phase 2	Yellow	White (Green TP)
Motor Ground	Black & Green	Black & Green
A+ / COS+	Brown	Blue
A- / COS-	Orange	White (Blue TP)
B+ / SIN+	Yellow	Brown
B- / SIN-	Green	White (Brown TP)
Index +	Violet	Violet
Index -	Blue	White (Violet TP)
+5V	Red	White (Grey TP)
GND	Black	Grey

A.7.1 Legacy Dimensions



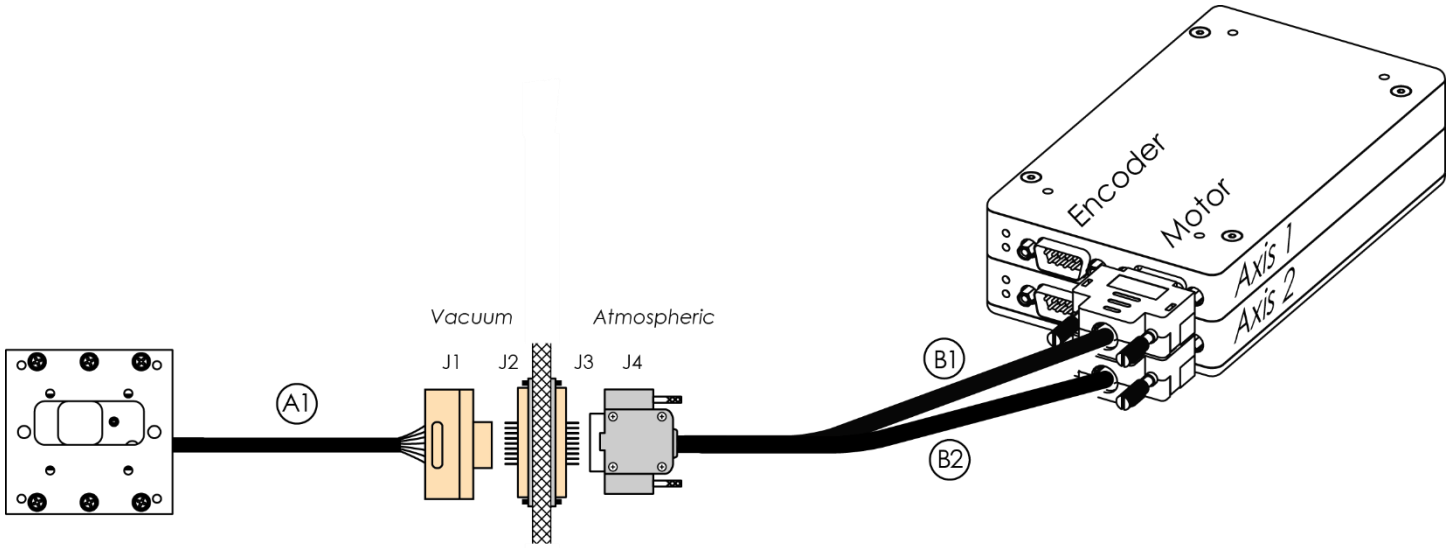
*Grey parts are for closed loop version only
All dimensions in millimeters

A.7.2 Legacy – Piezo, Digital, Atmospheric Wiring Diagram



PPX-32CR, Piezo Motor, Closed Loop, Atmospheric Wiring Diagram, Digital Encoder

A.7.3 Legacy – Piezo, Open Loop, Vacuum Wiring Diagram



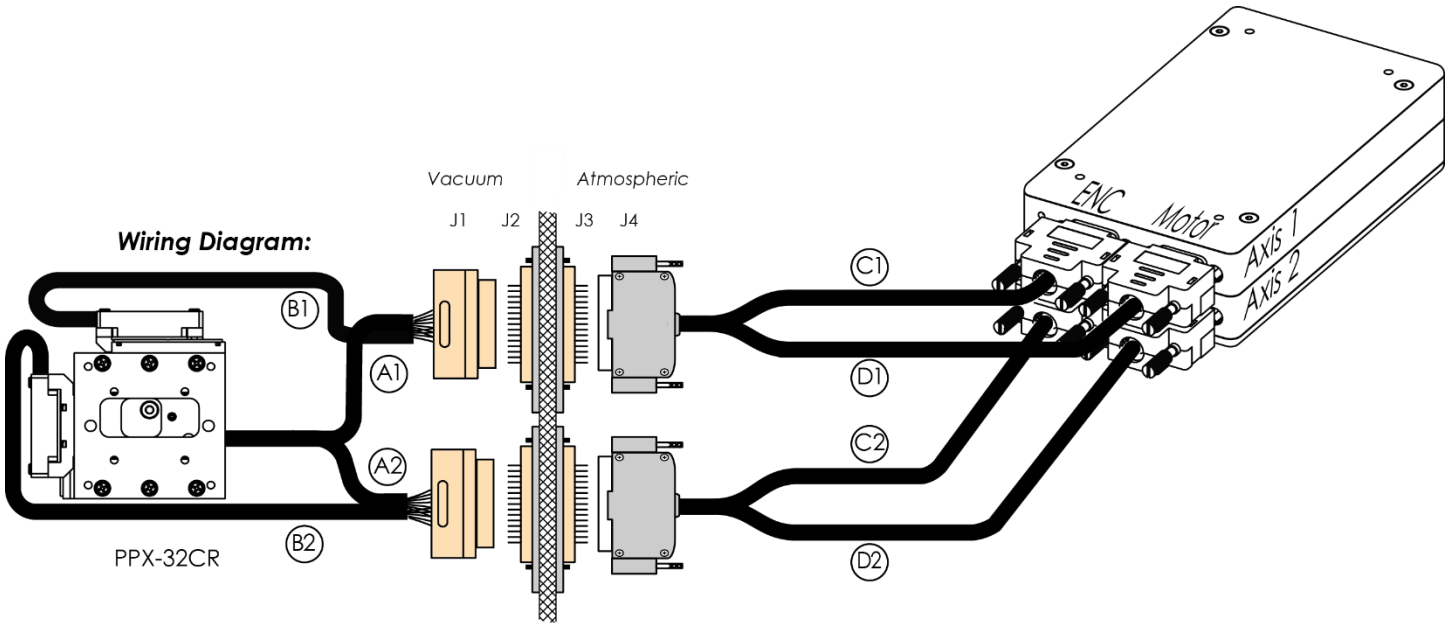
Legacy PPX-32CR-11306/9 – Piezo, Digital Encoder, Vacuum Pinout

A.7.3.1 Legacy PPX-32CR-11006/9 Pinouts

Pinout for Axis 1&2 Cables A1, B1, B2

	Description:	Color	J1	J2	J3	J4	J5	
A1	X-Phase 1	Red	1	1	5	5 (Red)	1	B1
	X-Phase 2	Yellow	2	2	4	4 (White - Green TP)	2	
	X-Ground	Black/Green	6	6	9	9 (Black & Green)	5	
	Shield	-	7	7	8	8 (Shield)	Casing	
	Y-Phase 1	Blue	5	5	1	1 (Blue)	1	B2
	Y-Phase 2	Orange	4	4	2	2 (Violet)	2	
	Y-Ground	Violet/Brown	9	9	6	6 (White - Blue&Viol. TP)	5	
	Shield	-	8	8	7	7 (Shield)	Casing	

A.7.4 Legacy – Closed Loop, Analog Encoder, Vacuum Wiring Diagram



PPX-32CR, Piezo Motor, Closed Loop, Vacuum Wiring Diagram, Analog Encoder

A.7.4.1 Legacy PPX-32CR-11206/9 Pinouts

Pinout for Axis 1 Cables A1, B1, C1, D1

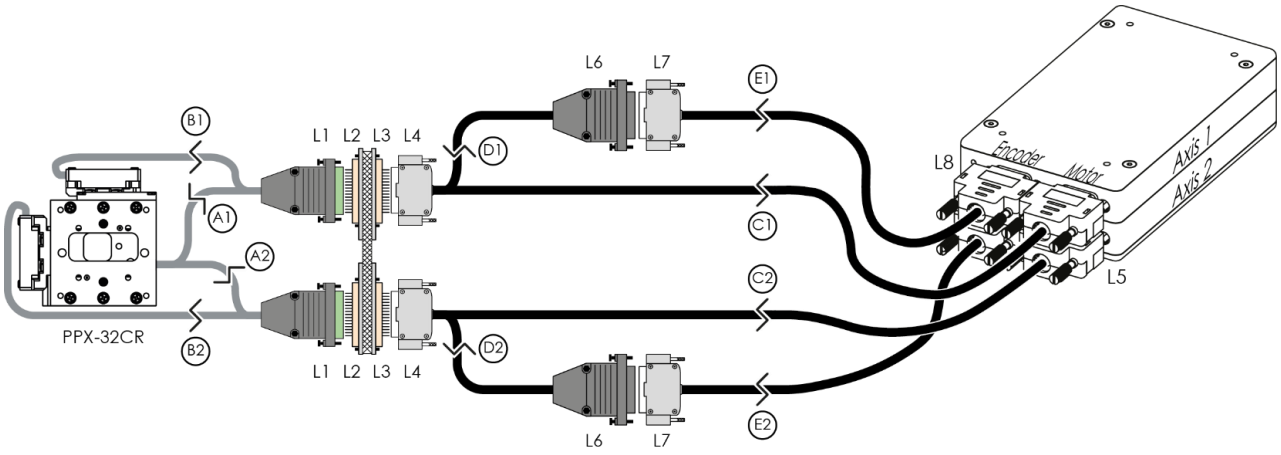
	Description:	Color	J1	J2	J3	J4	J5
A1 & D1	Phase 1	Red	1	1	8	8 (Red)	1
	Phase 2	Yellow	2	2	7	7 (White - Green TP)	2
	Ground	Black/Green	9	9	15	15 (Black & Green)	5
	Shield	-	10	10	14	14 (Shield)	Casing
B1 & C1	GND	Black	8	8	1	1 (Black)	4
	Cos+	Brown	7	7	2	2 (Brown)	1
	+5V	Red	6	6	3	3 (Red)	5
	Cos-	Orange	5	5	4	4 (White-Brown TP)	6
	Sin+	Yellow	4	4	5	5 (Yellow)	2
	Sin-	Green	12	12	12	12 (White - Yellow TP)	7
	Index-	Blue	13	13	11	11 (White - Violet TP)	8
	Index+	Violet	14	14	10	10 (Violet)	3
	Shield	-	15	15	9	9 (Shield)	Casing

Vacuum *Atmospheric*

Pinout for Axis 2 Cables A2, B2, C2 D2

	Description:	Vac Color	J1	J2	J3	J4	J5
A2 & D2	Phase 1	Blue	1	1	8	8 (Red)	1
	Phase 2	Orange	2	2	7	7 (White - Green TP)	2
	Ground	Violet/Brown	9	9	15	15 (Black&Green)	5
	Shield	-	10	10	14	14 (Shield)	Casing
B2 & C2	GND	Black	8	8	1	1 (Black)	4
	Cos+	Brown	7	7	2	2 (Brown)	1
	+5V	Red	6	6	3	3 (Red)	5
	Cos-	Orange	5	5	4	4 (White - Brown TP)	6
	Sin+	Yellow	4	4	5	5 (Yellow)	2
	Sin-	Green	12	12	12	12 (White - Yellow TP)	7
	Index-	Blue	13	13	11	11 (White - Violet TP)	8
	Index+	Violet	14	14	10	10 (Violet)	3
	Shield	-	15	15	9	9 (Shield)	Casing

A.7.5 Legacy – Closed Loop, Digital Encoder, Vacuum Wiring Diagram



PPX-32CR, Piezo Motor, Closed Loop, Vacuum Wiring Diagram, Digital Encoder

A.7.5.1 Legacy PPX-32CR-11306/9 Pinouts

Pinout for Axis 1 Cables A1, B1, C1, D1

	Description:	Color	J1	J2	J3	Atmo Color	J4	J7	J8
Motor A1 & D1	Phase 1	Red	1	1	8	Red	8	-	1
	Phase 2	Yellow	2	2	7	White - Green TP	7	-	2
	Ground	Black/Green	9	9	15	Black & Green	15	-	5
	Shield	-	10	10	14	-	14	-	Casing
Encoder B1, C1, E1	GND	Black	8	8	1	Black	1	4	
	Cos+	Brown	7	7	2	Brown	2	1	
	+5V	Red	6	6	3	Red	3	5	
	Cos-	Orange	5	5	4	Orange	4	6	
	Sin+	Yellow	4	4	5	Yellow	5	2	
	Sin-	Green	12	12	12	Green	12	7	
	Index-	Blue	13	13	11	Blue	11	8	
	Index+	Violet	14	14	10	Violet	10	3	
	Shield	-	15	15	9	-	9	Casing	
				Vacuum		*Atmospheric*			

Pinout for Axis 2 Cables A2, B2, C2 D2

	Description:	Vac Color	J1	J2	J3	Atmo Color	J4	J7	J8
Motor A2 & D2	Phase 1	Blue	1	1	8	Red	8	-	1
	Phase 2	Orange	2	2	7	White - Green TP	7	-	2
	Ground	Violet/Brown	9	9	15	Black & Green	15	-	5
	Shield	-	10	10	10	-	14	-	Casing
Encoder B2, C2, E2	GND	Black	8	8	1	Black	1	4	
	Cos+	Brown	7	7	2	Brown	2	1	
	+5V	Red	6	6	3	Red	3	5	
	Cos-	Orange	5	5	4	Orange	4	6	
	Sin+	Yellow	4	4	5	Yellow	5	2	
	Sin-	Green	12	12	12	Green	12	7	
	Index-	Blue	13	13	11	Blue	11	8	
	Index+	Violet	14	14	10	Violet	10	3	
	Shield	-	15	15	9	-	9	Casing	